MATHEMATICAL MODELING OF SIZE FEATURES

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Abstract: *Because of the high variability of size features and their random nature made observations on fifty four pregnant women from the second to the ninth months of the pregnancy.*

The main objective of the article is to determine the changes in the diagnostic parameter "waist" in the pregnancy and to do a mathematical model based on the regression analysis.

Keywords: *methods of regression analysis, size features.*

1. INTRODUCTION

Motherhood is desirable and exciting event for every woman. This physiological state does not exclude her from participation in work and social activities. The mother wishes to retain their place in society, has right to remain stylish and attractive throughout the pregnancy. Therefore she needs not only domestic and everyday clothes but working and official wear also. The types of clothing for pregnant women should be considered in connection with their seasonal use - winter, summer and transient. The pregnant women need more than 20 kinds of products (only accessories are not required to be specific). In the eighties of 20 century the manufacturers have taken up the difficult task - making these types and offering them in specialized stores and stands. Clothing for pregnant women became an assortment of the fashion houses and went on the podium in the collections of fashion shows.

Much of expectant mothers prefer to buy confection in shops to custom made wear but at this point marketing network is not able to offer sufficient choice or there are not some special types of clothing for this time of woman life [5].

The specifics of the confection for expectant mothers off equating it to a giant group where the volume of products increased total and changes in pregnancy are partial and specific.

For example, tights giant reach middle of the abdomen and tighten making them unsuitable. This concern the underwear and outerwear of the same group. For this reason, expectant mothers should be directed to the special assortments for pregnant women.

The good fit of clothing is the main quality of the garment which greatly concerns both consumers and people working in the fashion industry. They determine comfort, silhouette attractiveness in parallel with the design and the fabric.

During the pregnancy it is necessary to use more specific clothing adapted to the changing shapes of the body - more functional and practical. Condition of the pregnant suggests a tendency to varicose veins, edema, hypersensitivity and allergy which requires more careful selection of clothing in fabrics, cuts and accessories, as well as appropriate shoes.

2. EXHIBITION

Because of the high variability of feature signs and their random nature, depending on the particular case, there are no comprehensive research in this area and their mathematical processing [1, 2, 3, 4, 6]. The most important changes in a woman body during pregnancy that have occurred are weight, waist, and bust increasing. They are in direct relation with the size features required for constructing and modeling clothing.

Table 1. Distribution of waist size – month

N\ month	2	3	4	5	6	7	8	9
1	63	63	65	72	76	83	87	93
2	72	74	78	85	87	91	93	95
3	73	74	79	84	87	92	94	97
4	68	68	70	73	75	78	86	88
5	63	63	69	73	79	80	81	88
6	74	76	78	80	86	88	102	103
7	78	78	82	88	92	99	103	104
8	70	72	85	86	87	89	97	98
9	69	72	87	91	93	93	100	103
10	57	60	62	67	70	78	85	90
11	86	87	92	93	94	96	99	99
12	66	72	76	80	86	90	95	100
13	64	68	70	74	78	86	93	100
14	64	68	72	76	85	88	91	95
15	80	81	83	88	94	96	98	100
16	77	80	83	85	87	98	101	98
17	72	73	82	84	88	90	93	94
18	94	96	100	100	101	101	102	103
19	62	70	72	76	79	81	86	98
20	76	80	83	85	87	93	100	105
21	78	80	83	85	86	87	90	90
22	88	90	94	94	96	103	104	109
23	83	84	90	95	100	100	101	102
24	60	60	62	87	90	94	95	96
25	90	94	98	99	100	101	103	105
26	92	93	98	98	99	101	105	107
27	89	90	91	99	102	105	106	111
28	79	80	84	89	86	86	88	92
29	87	87	90	90	94	99	100	103
30	71	72	77	77	82	86	103	100
31	86	87	87	87	92	94	99	106
32	80	81	82	83	89	94	96	101
33	78	79	80	84	84	89	95	96
34	68	69	76	75	77	80	79	84
35	92	93	94	94	97	104	103	108
36	114	115	119	118	120	125	124	126
37	90	91	93	93	95	93	98	101
38	94	95	97	97	101	106	107	109
39	84	85	87	88	90	90	91	93
40	110	111	112	113	114	115	119	119
41	94	95	96	97	98	102	107	110
42	81	82	88	87	88	92	95	99
43	73	74	75	76	88	87	87	92
44	75	76	76	77	78	82	85	88
45	84	85	87	90	93	94	96	99
46	81	82	89	93	93	95	98	101

47	87	88	88	93	100	101	106	108
48	91	92	94	96	100	104	107	111
49	87	88	90	94	99	102	105	104
50	95	95	96	95	95	99	100	103
51	74	75	75	79	81	85	88	94
52	79	80	77	75	86	88	89	94
53	82	83	85	87	88	91	94	99
54	93	94	93	97	96	98	99	102
average value	79.94444	81.48148	84.64815	87.42593	90.51852	93.74074	97.18519	100.2407
average deviation	11.93444	11.54113	11.23028	10.00491	9.31167	9.074503	8.543063	7.791953

In this paper we confine to the preparation of a mathematical model using the method of regression analysis of size feature - waist size. The observations have done on fifty-four pregnant women from the second to the ninth month of pregnancy. The resulting data is displayed in Table 1.

The data obtained for each month can be displayed graphically in the following chart.

Figure 1. Chart of size feature of "waist size" in time

In order to avoid the accumulation we will show only a part of the individual implementations of size feature. Each obtained curve we can interpret as a random function with an uncaused argument – time.

Figure 2. Chart of some of the various implementations of size feature

From the obtained chart we can conclude that the random process is relatively smooth and it has not got a chaotic nature. This can be calculated with correlation coefficients calculated for individual months showed in Table 2.

Table 2. Correlation coefficients calculated for individual months

	2	3	4	5	6	7	8	9
2	1.000							
3	0.992	1.000						
4	0.954	0.964	1.000					
5	0.902	0.907	0.940	1.000				
6	0.888	0.892	0.909	0.962	1.000			
7	0.866	0.871	0.876	0.932	0.962	1.000		
8	0.790	0.803	0.821	0.863	0.890	0.933	1.000	
9	0.773	0.799	0.798	0.830	0.867	0.914	0.955	1.000

By the obtained data we checked some mathematical models as suitable. The most suitable model is polynomial of second order that have the general form:

$$y = b_0 + b_1t + b_2t^2 \quad (1)$$

Statistical processing of the data shows that the coefficient of determination $R^2 = 0.998$, practical unit, shows that almost 100% of the change of the parameter y – waist size is due to controllable factors t and it is described by the using model. From several studied models, in this model the determination coefficient is the highest. Statistically significant are all coefficients of the polynomial. They are as follows:

$$b_0 = 75,21; b_1 = 2,00; b_2 = 0,08.$$

Fisher criterion $F = 1669$ and its corresponding probability $p < 0.0000$ indicates that the model describes the essential part of modification of y .

The final form of the equation is:

$$y = 75,21 + 2,00t + 0,08t^2 \quad (2)$$

Resulting regression model describes a surface $y = f(t)$ in R^2 that we can show graphically.

Figure 2 Regression line and area of the predicted value of Y

From obtained regression equation and the calculated statistics we can try to predict the change of size feature in each case (realization). This will eliminate the constant and will put it as an initial condition for each implementation:

$$y = c + 2,00t + 0,08t^2, \quad y(t_0) - 2,00t_0 + 0,08t_0^2 = c$$

or

$$y = y(t_0) - 2,00t_0 + 0,08t_0^2 + 2,00t + 0,08t^2 \pm \sigma,$$

where σ is calculated in Table 1.

3. CONCLUSIONS

From the obtained results we can conclude:

1. We have obtained data of the type of process and calculated correlation coefficient.
2. We have obtained a mathematical model of size feature – “waist size” that in details describes that size.
3. We have obtained an analytic dependence that allows prediction of size feature in the different periods of pregnancy. This allows engineers and designers to provide adequate allowance for freedom when they design clothing for pregnant women.

4. REFERENCES

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